Tracking Performance Limitations In LTI Multivariable Discrete-Timesystems

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Summary

In this paper, we investigate tracking properties of linear shift-invariant feedback control systems. We consider the standard unity feedback configuration, and use the energy of an error signal as a measure of tracking ability. Our main goal is to understand the fundamental limitation on tracking performance, which can arise due to the nonminimum phase zeros, unstable poles, and time delays in the plant, and which varies with input reference signals. We consider step, ramp, and sinusoidal signals, and for each type of the signals we derive a closed form expression for the minimum tracking error attainable by any stabilizing controller. Our results display an explicit dependence of the tracking error on nonminimum phase zeros, unstable poles, and in particular the coupling between the directions of the poles and zeros, and those of the input reference signal, upon which a number of useful conclusions can be drawn. One interesting outcome is that not only zero and pole locations affect tracking performance, but their directional properties also play an important role. The paper provides a nontrivial extension of the previously available results to discrete-time systems, with a consideration on broader classes of reference inputs